Does Your Schedule Pass the Test ?

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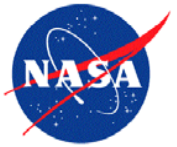
3/22/05

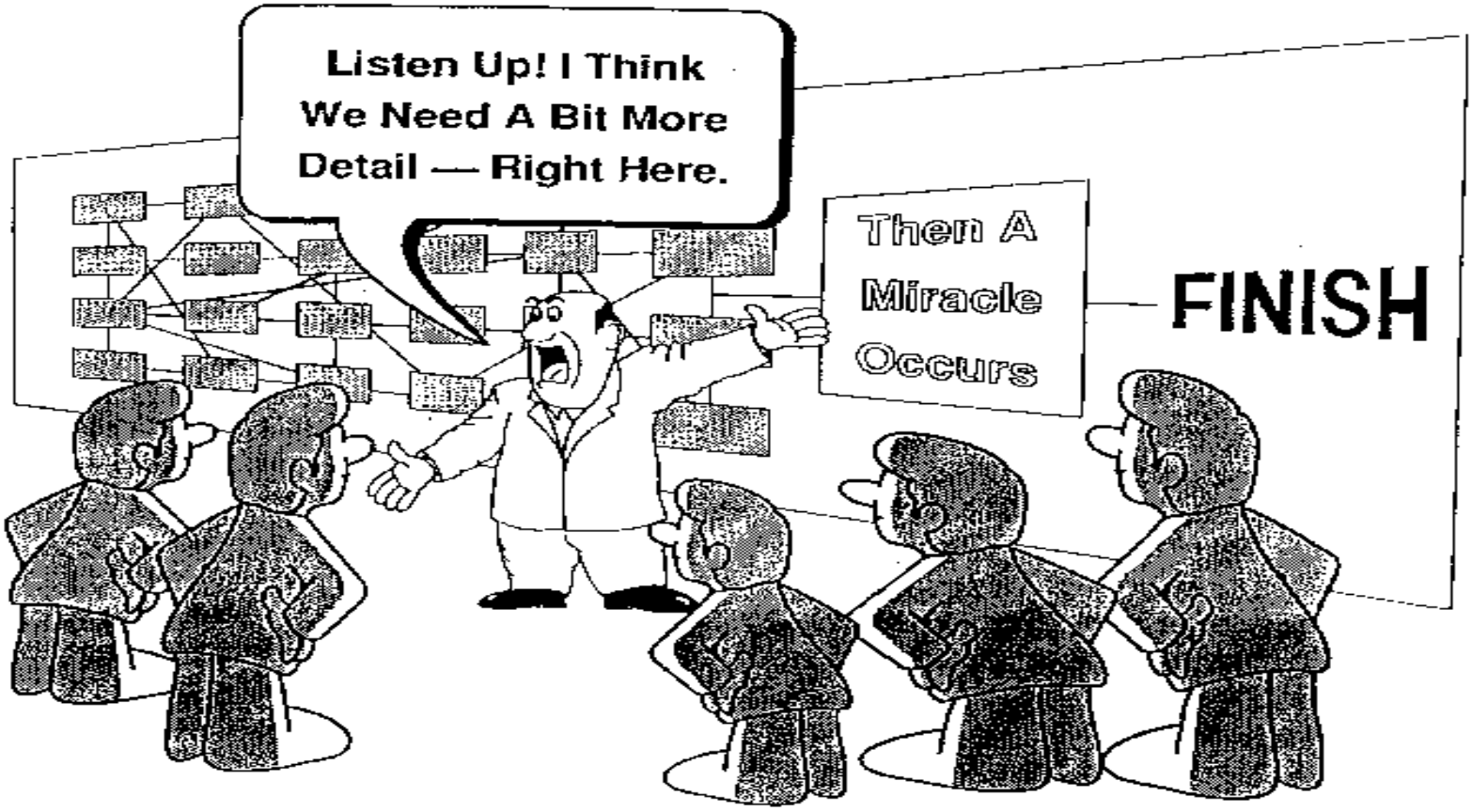
Topics



- Why Assess?
- Key Schedule Components
- Credibility Indicators
- Testing Your Schedule

Why Assess?

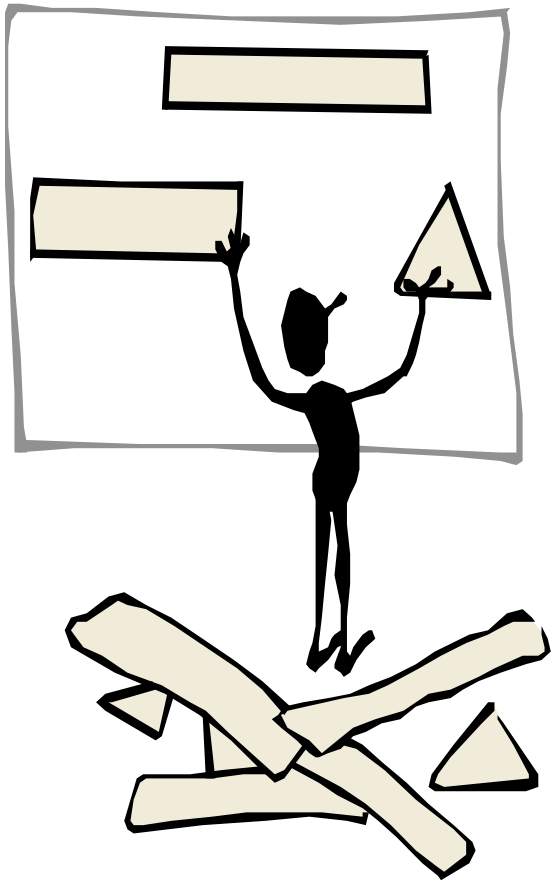
To Avoid This!



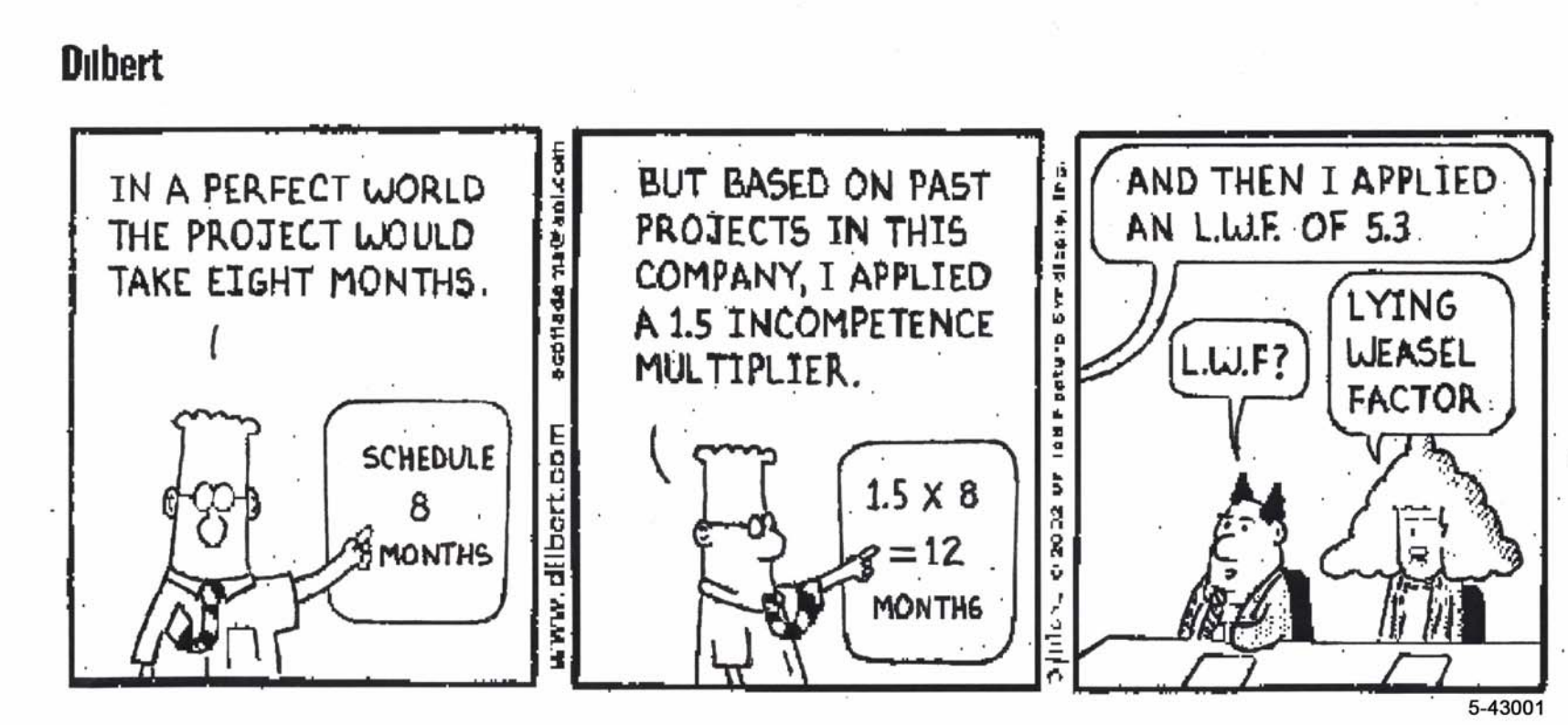
Why Assess?

Objective:

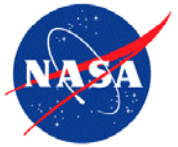
To provide you with a strategy for determining a schedule's integrity and credibility.



Why Assess?


Dilbert
IN A PERFECT WORLD THE PROJECT WOULD TAKE EIGHT MONTHS.
SCHEDULE 8 MONTHS
BUT BASED ON PAST PROJECTS IN THIS COMPANY, I APPLIED A 1.5 INCOMPETENCE MULTIPLIER.
1.5 X 8 =12 MONTHS
AND THEN I APPLIED AN L.W.F. OF 5.3
L.W.F?
LYING WEASEL FACTOR
5-43001

Why Assess?



- May not reflect the total scope of work
- May not be integrated
  - *Internally (task/milestone interdependencies)*
  - *Externally (other NASA facilities, contractor schedules, vendor deliveries, etc.)*
- May reflect an inaccurate model of planned implementation
- May reflect inaccurate or incomplete status
- May not have an established baseline
- May not be capable of providing for Critical Path identification or slack for all tasks and milestones
- May provide an incorrect basis for resource planning
- May not be reasonable or even feasible
- May not provide for “What-if” analysis

Topics

- Why Assess?
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- Credibility Indicators
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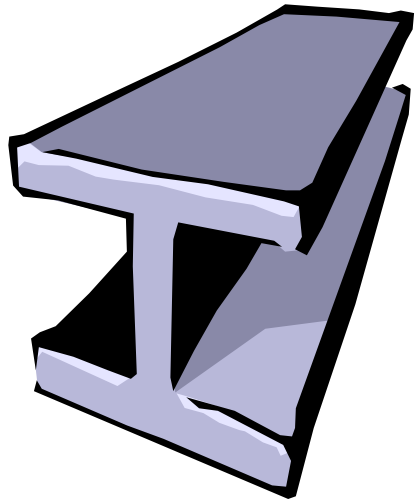
Key Schedule Components

- Use a management tool with Critical Path Method (CPM) functionality

  No - Powerpoint, Milestones, FastTrack, etc.,

  Yes - MS Project, Primavera, Open Plan, Suretrak, Dekker Trakker, AMS Real Time, etc.



- Sound Network Logic?

  (Network Logic:) – A model that reflects the planned project implementation and sequencing through the use of task/milestone interdependencies, durations, and date constraints

(Note: A sound Network Logic should provide the basis of all project schedule data)

Key Schedule Components

Network Logic (Types of Interdependencies)

Predecessor: - A task or milestone that must occur either partially or totally prior to another task

Successor: - A task or milestone that must follow either partially or totally another task

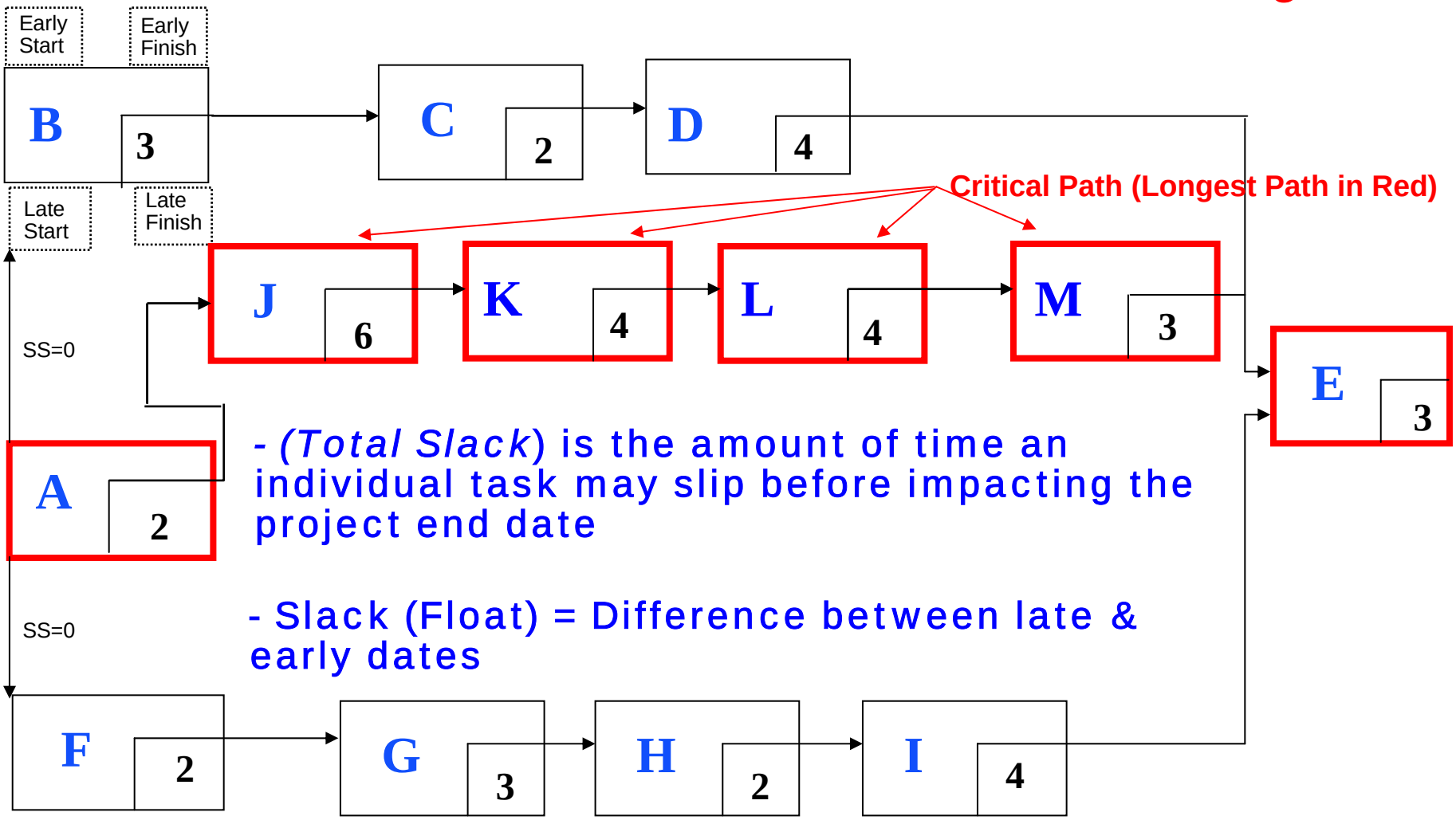
- Finish-to-Start Relationship: **Task #1 must finish before Task #2 can start**
- Finish-to-Finish Relationship: **Task #1 must finish before Task #2 can finish**
- Start-to-Start Relationship: **Task #1 must start before Task #2 can start**
- Start-to-Finish Relationship: **Task #1 must start before Task #2 can finish (rarely used)**

Note 1: Lag & lead values can also be assigned to better simulate the sequence of work

Note 2: Caution, do not assign logic relationships to summary tasks (summary logic overrides detail task logic)

Key Schedule Components

End-to-End Network Logic



- *(Total Slack)* is the amount of time an individual task may slip before impacting the project end date

- Slack (Float) = Difference between late & early dates

Key Schedule Components

- Content & Level of detail:
  - **Include <u>all</u> elements of the approved WBS**
  - **Most tasks must be discrete & measurable**
- Constraint dates:
  - **Overrides logic & controls slack calculation**
  - **Impacts critical path**
  - **Use only when really needed**
- Task Coding: (WBS, Organization, System, Phase, etc.)
  - **Sort, select, and summarization of data**
- Task descriptions (complete & understandable)

(Note: Very important when analyzing critical path due to summary tasks not being included)

Key Schedule Components

- Status Portrayal:
  - **Show what has been accomplished & true date it was finished**
  - **Reflect new start/finish forecasts**
  - **Impacts projected end dates**
  - **Enables comparing current to baseline**
- Work Calendars:
  - **Hours per day / days per week**
  - **Holidays**
  - **Shifts**

Topics

- Why Assess?
- Key Schedule Components
- Credibility Indicators
- Testing Your Schedule

Credibility Indicators

- Number of missing Logic ties (Interdependencies):
  - **All tasks & milestones should have interdependencies assigned (exceptions: project start & completion, external deliveries, etc.)**

Note: **Missing Logic can be identified in seconds by the automated management tools (ie; MS Project, Primavera, Open Plan, etc.)**

Impacts:

- **Tasks with no successors may slip with no resulting visible impacts**
- **Tasks with no predecessors may incorrectly reflect start dates much too early**
- **Prevents accurate Critical Path identification**
- **Prohibits the use of slack values in managing resources**
- **Prevents credible "what-if" analyses**
- **Prohibits adequate schedule risk analyses**

Credibility Indicators

- Number of constraint dates
  - **As Soon As Possible**
  - **As Late As Possible** *(Not Recommended in MS Project!)*
  - **Start No Earlier Than**
  - **Start No Later Than**
  - **Finish No Earlier Than**
  - **Must Start On**
  - **Must Finish On**
  - **Deadline** *(Is not listed as a constraint within MS Project, but has the same result & impact as a constraint)*

Note: Ideally, minimal use of constraints, other than "As Soon As Possible" is strongly recommended

Impact: Prohibits accurate slack calculations for total project, critical path identification & analyses, and potentially incorrect task start / finish dates

Credibility Indicators

- Number of inaccurate or improperly statused tasks
  - **Incomplete, past due tasks & milestones with no revised forecasts**
  - **Assigning actual start/finish dates (later than status date) on tasks that are scheduled to occur in the future**
  - **"status-as-of" date too far in the past to be meaningful**

Note: Some scheduling software will allow incomplete tasks to remain in the past with no revised forecast dates

Impact: Prohibits accuracy in slack calculations, critical path identification & analyses, and task start/finish projections – (hinders confidence in schedule)

Credibility Indicators

- Number of summary tasks with interdependencies assigned

  Note: The details should drive the summary tasks

  Impact: Summary Logic will override detail logic and potentially cause wrong dates

- Percentage of remaining tasks with less than 10 days of slack
  - **If more than 50%, could indicate that the schedule is much too optimistic, if less than 5% could indicate missing interdependencies**

  Note: The schedule probably needs re-planning

  Impact: Schedule dates may not be realistic or achievable

- Percentage of remaining tasks with too much slack

  Note: Good indicator of missing interdependencies

  Impact: Potential for incorrect dates and slack value

Credibility Indicators

- Is Critical Path Credible? (Yes / No)

  - **Does it contain LOE or support tasks?**
  - **Does it start with a current task?**
  - **Does it flow to project completion?**
  - **Does it consistently reflect the lowest total slack value on each task in the sequence?**
  - **Does it reflect the correct sequence?**
  - **Is the level of detail appropriate? (durations too large?)**
  - **Do the descriptions clearly tell what the tasks are?**

Agenda

- Why Assess?
- Key Schedule Components
- Credibility Indicators
- Testing Your Schedule

Testing Your Schedule

Test #1 – Schedule Content Verification Check

- **Verifies all WBS elements are included in schedule**

Test #2 - Schedule Health Check

- **Quantitative report of key indicators that reflect integrity of schedule data**
- **Helps establish realistic baselines**
- **Provides an additional metric to track schedule integrity and improvement**
- **Provides management the right questions to ask about the schedule**

Test #3 – Critical Path Credibility Check

- **Provides quick "common sense" validity check of stated critical path**
- **Helps identify items that should not be on Critical Path**

Testing Your Schedule

Test #4 - Schedule Work-Off Trend

- **Statistical comparison of actual start/finish achievement vs. projected start/finish requirements to assess schedule credibility**

Test #5 - Probabilistic Schedule Risk Analysis

- **Use Monte Carlo simulations with realistic risk information from technical team applied to network logic to assess schedule confidence**

Test #6 – Summary Level Cost/Schedule Correlation Check

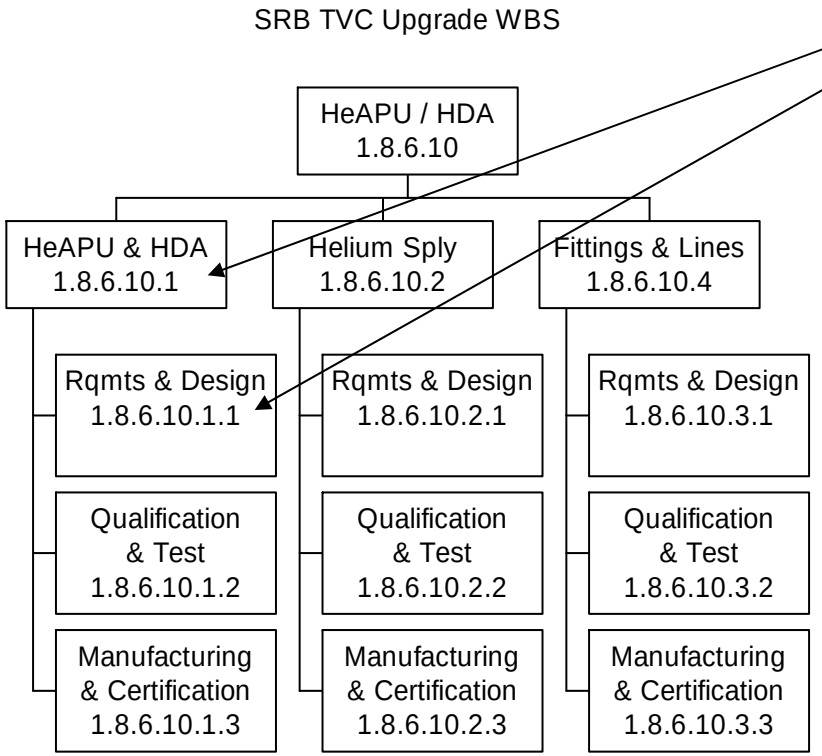
- **High level comparison of schedule phasing & resource phasing to validate integration**

Testing Your Schedule

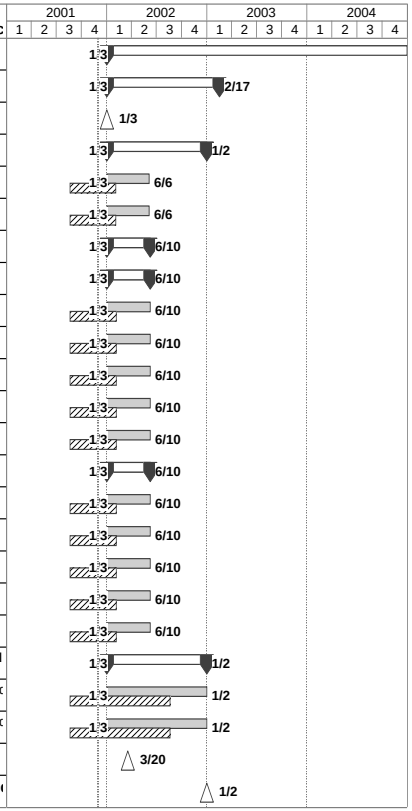
- *Test #7 - Major Milestone Tracking Check*
  - **Monitors slippage in early major milestones to ensure impacts are reflected in later key milestones**
- *Test #8 - Project Schedule Reserve Check*
  - **Identifies the amount of project schedule margin in the plan and tracks the usage of that reserve**

Test #1 - Schedule Content Verification

Verify All WBS Elements are in Schedule



ID	2 CWBS	Task Name	Dur	Slac
310	1.8.6.10.1	**HeAPU/HeDA**	786d	0d
311	1.8.6.10.1.1	**Design Phase**	249d	0d
312	1.8.6.10.1.	**ATP to Sundstrand**	0d	0d
313	1.8.6.10.1.1	**Hamilton Sundstrand Design & L**	221d	0d
314	1.8.6.10.1.1	HeDA Design	97d	0d
315	1.8.6.10.1.1	HeAPU Design	97d	0d
316	1.8.6.10.1.1	**Analysis**	98d	2d
317	1.8.6.10.1.1	**HeDA**	98d	2d
318	1.8.6.10.1.1	Stress Analysis	98d	2d
319	1.8.6.10.1.1	Thermal Analysis	98d	2d
320	1.8.6.10.1.1	Vibration & Shock Analys	98d	2d
321	1.8.6.10.1.1	Operating Life	98d	2d
322	1.8.6.10.1.1	Performance Analysis	98d	2d
323	1.8.6.10.1.1	**HeAPU**	98d	2d
324	1.8.6.10.1.1	Stress Analysis	98d	2d
325	1.8.6.10.1.1	Thermal Analysis	98d	2d
326	1.8.6.10.1.1	Vibration & Shock Analys	98d	2d
327	1.8.6.10.1.1	Operating Life	98d	2d
328	1.8.6.10.1.1	Performance Analysis	98d	2d
329	1.8.6.10.1.1	**Drawings/Detail**	221d	48d
330	1.8.6.10.1.1	HeDA	221d	119(
331	1.8.6.10.1.1	HeAPU (with containment)	221d	119(
332	1.8.6.10.1.	**EP Drawings Complete**	0d	0d
333	1.8.6.10.1.	**Production Drawings C(**	0d	119(



Test #2 - Schedule Health Check

		Overall Rating		
Project Name: **Project XYZ**			R	
Contractor: Acme Engineering				**Schedule Health Check Rating Criteria:**
File Type: **MS Project**		***Current***		For missing predecessors, successors less than 5% is green;
Schedule Status				from 5% to 10% is yellow; and greater than 10% is red.
Current Start (earliest activity Early Start date)		1/1/2001		For Constraints & Deadlines, less than 10% is green, 10% to 15%
Current Finish (latest activity Early Finish date)		3/16/2004		is yellow, and greater than 15% is red.
Approximate Remaining Work Days		722		For tasks needing updates, actuals after the status date,
Is this schedule externally linked to other schedules? (Y/N)		N		and tasks marked as milestones 0% is green; greater than
Status Date		6/15/2001		0% up to 5% is yellow and over 5% is red.
Task & Milestone Count (excluding Summary Tasks)	**Count**	**% of Total**		For summaries with logic ties less than 2% is green; 2%-3% is yellow;
Total Tasks & Milestones	192			greater than 3% is red.
Completed Tasks & Milestones	13	7%		The overall project rating is determined by assigning a numeric
To Go Tasks & Milestones	179	93%		value to the different colors i.e. red = 1, yellow = 2 and green = 3.
Logic (excluding Summary and Started/Completed Tasks)				The numbers are summed and a weighting factor is applied to
Tasks & Milestones Without Predecessors	75	42%	R	determine the final results. The average results are color coded
Tasks & Milestones Without Successors	73	41%	R	as follows: Red is less than 1.75, Yellow 1.75 to 2.5 and Green
Constraints (other than ASAP) and Assigned Deadlines	102	57%	R	greater than 2.5.
Summaries with Logic Ties **	1	1%	G	**Weighting for overall rating:**
Tasks & Milestones Needing Updates	21	12%	R	Missing Predecessors = 20%
Actuals after Status Date	2	1%	Y	Missing Successors = 20%
Tasks marked as Milestones (but have Duration > 0)	0	0%	G	Constraints & Assigned Deadlines = 15%
Additional Schedule Information				Summary tasks with logic ties = 10%
Schedule traceable to WBS (Y/N)	N			Tasks & Milestones Needing Status = 20%
Realistic Critical Path(s) (Y/N)	N			Actuals after the Status Date = 10%
Initial Schedule Baselined (Y/N)	N			Tasks marked as Milestones (but have Dur > 0) = 5%
Resource Loaded (Y/N)	N			
Tasks & Milestones with 10 days or less TF	1	1%		
Tasks with Total Float > 25% of RD (181 days)	148	83%		
** This number is calculated as a percentage of tasks & milestones				

- **Quantitative report of key indicators that reflect integrity of schedule data**

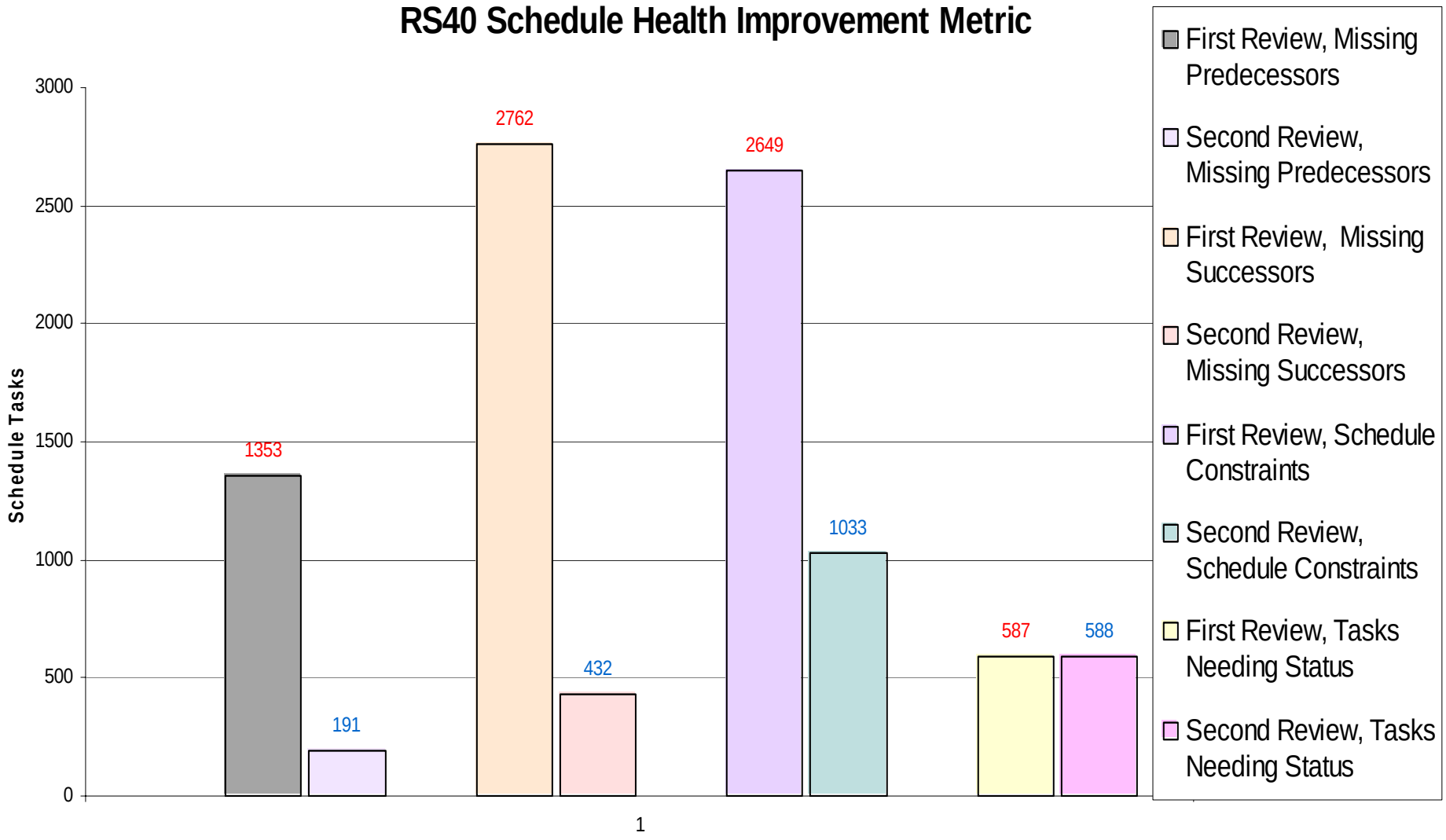
Schedule Health Check

Use Schedule Health Check for Improvement Metrics

		Overall Rating						
Project Name: **Project ABC**			G			R		
Contractor: **Company XYZ**								
File Type: **MS Project**	***Current***			***Previous***			***Change (C - P)***	
Schedule Status								
Current Start (earliest activity Early Start date)		1/9/2001			1/9/2001			
Current Finish (latest activity Early Finish date)		8/29/2003			7/23/2003		37	0%
Approximate Remaining Work Days		97			96		1	1%
Is this schedule externally linked to other schedules?		Y			Y			
Status Date		4/10/2003			3/3/2003			
Task & Milestone Count (excluding Summary Tasks)	Count	% of Total		Count	% of Total			
Total Tasks & Milestones	580			583				0%
Completed Tasks & Milestones	502	87%		468	81%			6%
To Go Tasks & Milestones	78	13%		115	20%			-6%
Logic (excluding Summary and Started/Completed Tasks)								
Tasks & Milestones Without Predecessors	0	0%	G	12	10%	R	-12	-10%
Tasks & Milestones Without Successors	1	1%	G	21	18%	R	-20	-17%
Constraints (other than ASAP) and Deadlines	2	3%	G	21	18%	R	-19	-16%
Summaries with Logic Ties **	0	0%	G	2	2%	G	-2	
Tasks & Milestones Needing Updates	0	0%	G	67	58%	R	-67	-58%
Actuals after Status Date	0	0%	G	0	0%	G	0	0%
Tasks marked as Milestones (have Duration > 0)	0	0%	G	0	0%	G	0	0%
Additional Schedule Information								
Schedule traceable to WBS (Y/N)	Y			N				
Realistic Critical Path(s) (Y/N)	Y			N				
Initial Schedule Baselined (Y/N)	Y			Y				
Resource Loaded (Y/N)	Y			N				
Tasks & Milestones with 10 days or less TF	4	5%		22	19%		-18	-14%
Tasks with Total Float > 25% of RD (24 days)	7	9%		81	70%		-74	-61%
** This number is calculated as a percentage of tasks & milestones								

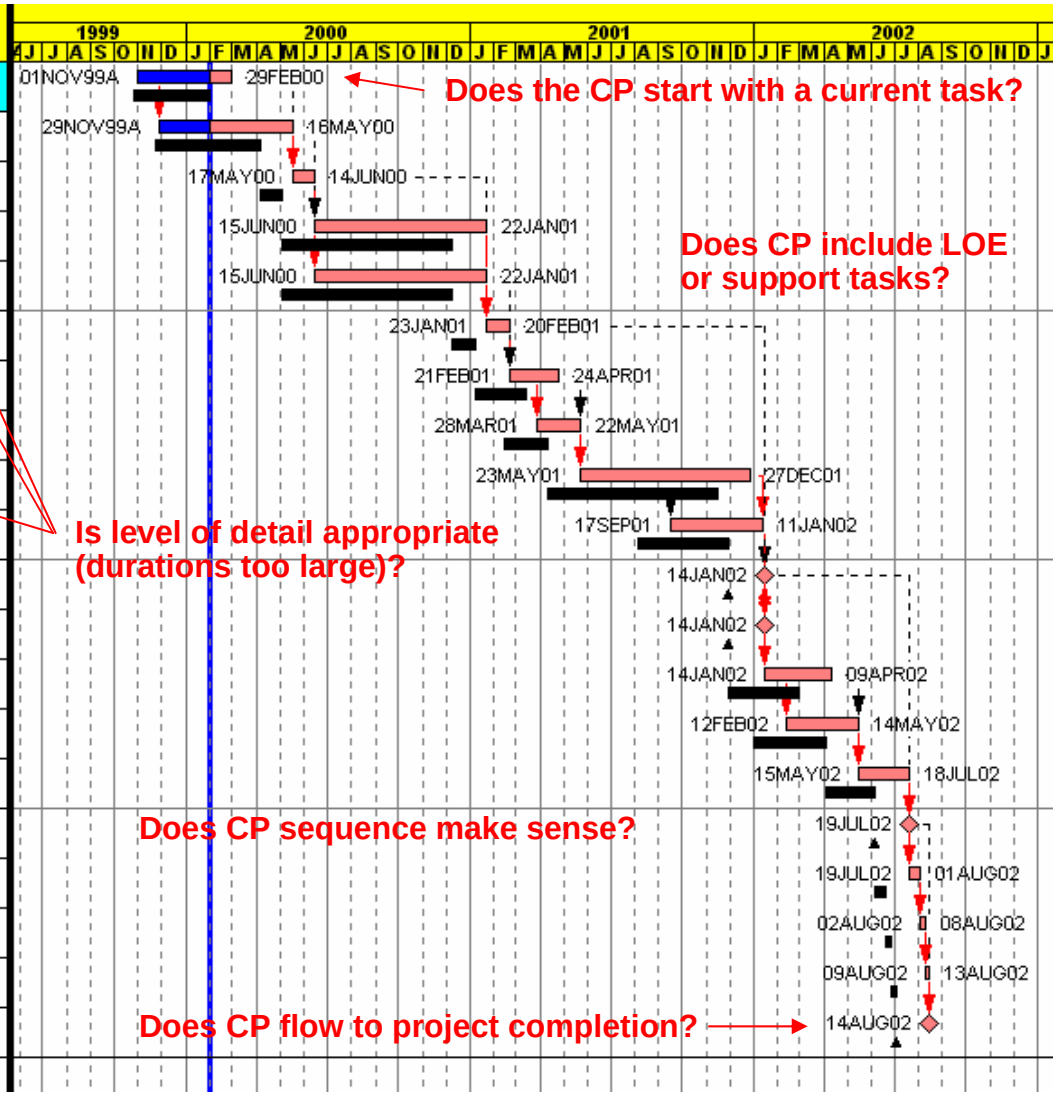
- **Provides an additional metric to track schedule integrity and improvement**

Schedule Health Check Metrics



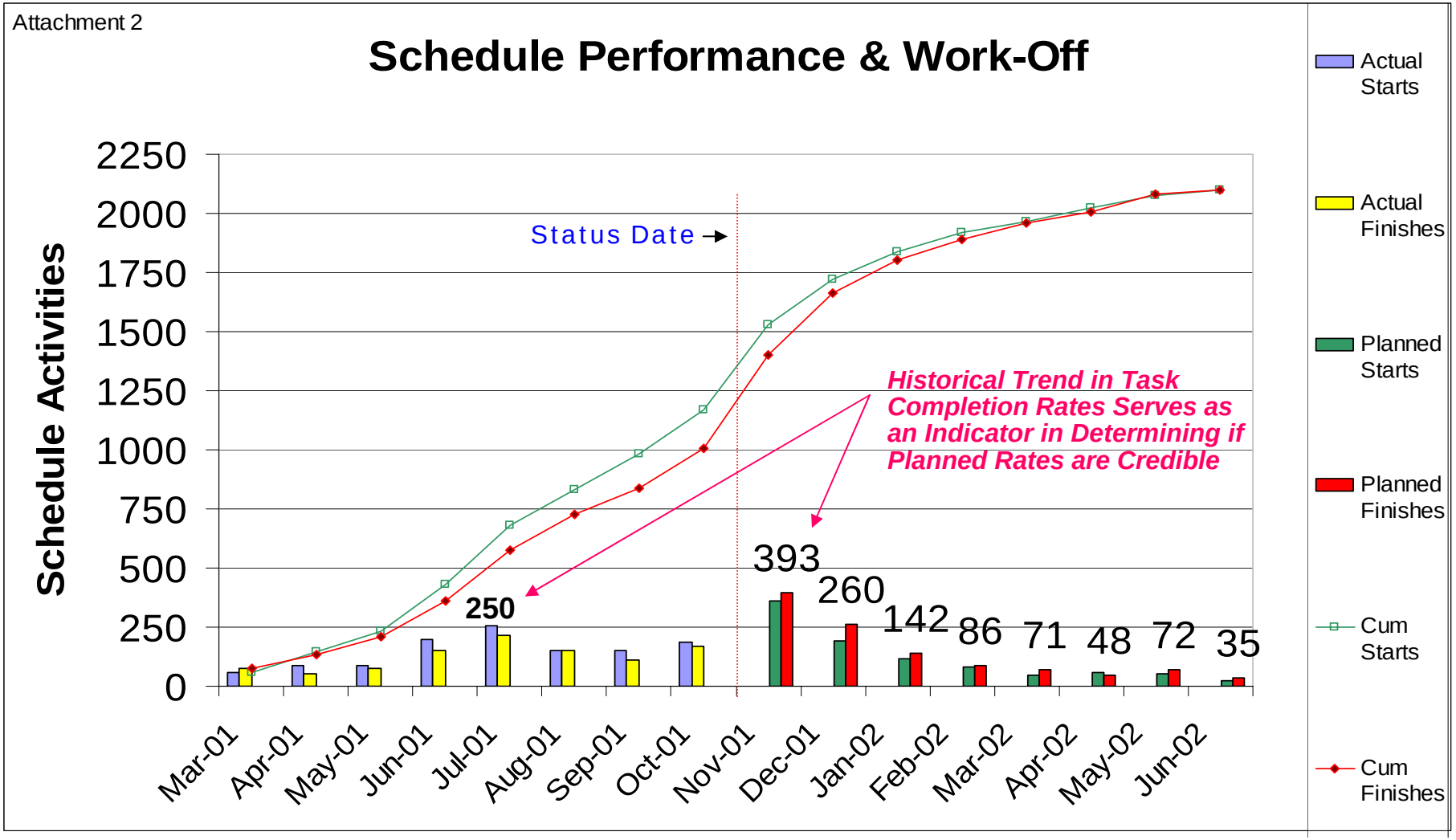
Test #3 - Critical Path Credibility Check

Activity ID	WBS	Activity Description	Rem Dur	Slack
0200	M.2.1	Develop Prelim Avionics Rqmts for PDR	20	0
0210	M.2.1	Dev Prelim Avionics Design & Analysis for PDR	75	0
0005	M	Preliminary Design Review (PDR)	20	0
0230	M.2.1	Compl Avionics Critical Design & Anal for CDR	150	0
0430	M.4.1	Compl Propulsion Critical Design & Anal for CDR	150	0
0010	M	Start Critical Design Review (CDR)	20	0
0440	M.4.1	Update Final Propulsion Drawings	45	0
0450	M.4.1	Baseline & Release Propulsion Dwgs to Mfg	40	0
0460	M.4.2	Propulsion Component Fabrication	150	0
0470	M.4.3	Propulsion Components Assy & C/O	80	0
0015	M	MUV Component Fabrication Complete	0	0
0480	M.4.3	Propulsion Components Available to I&T	0	0
0600	M.6.1	Integrate Subsystem Components	60	0
0610	M.6.2	Subsystem Functional Testing	65	0
0620	M.6.2	Full System Verification Testing	45	0
0025	M	MUV System Integration & Test Complete	0	0
0800	M.6.2	Final Pre-Ship Acceptance Review	10	0
0810	M.6.2	Prep & Package MUV Hardware for Shipment	5	0
0820	M.6.2	Ship MUV	3	0
0030	M	MUV Delivery	0	0



Test #4 – Schedule Work-Off Trend Check

Attachment 2

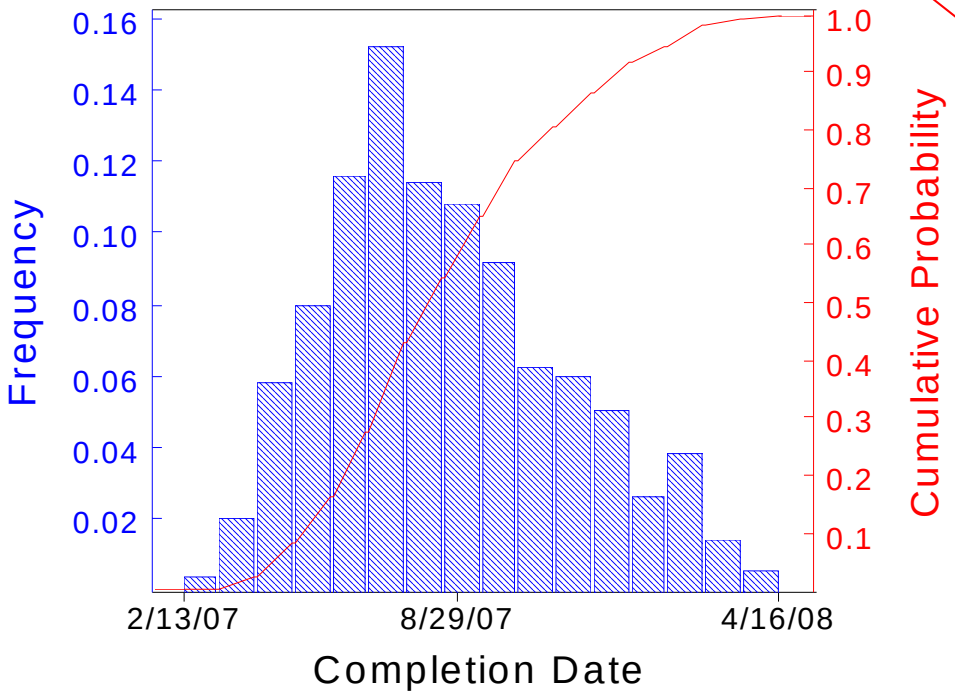


Test #5 – Probabilistic Schedule Risk Check

Date: 5/6/02 1:22:23 PM
Samples: 500
Unique ID: 580
Task: Hardware Delivery (8/20/07)

Applying the Confidence Parameters indicates that the Hardware Delivery has an 80% probability of slipping approximately 3 months!

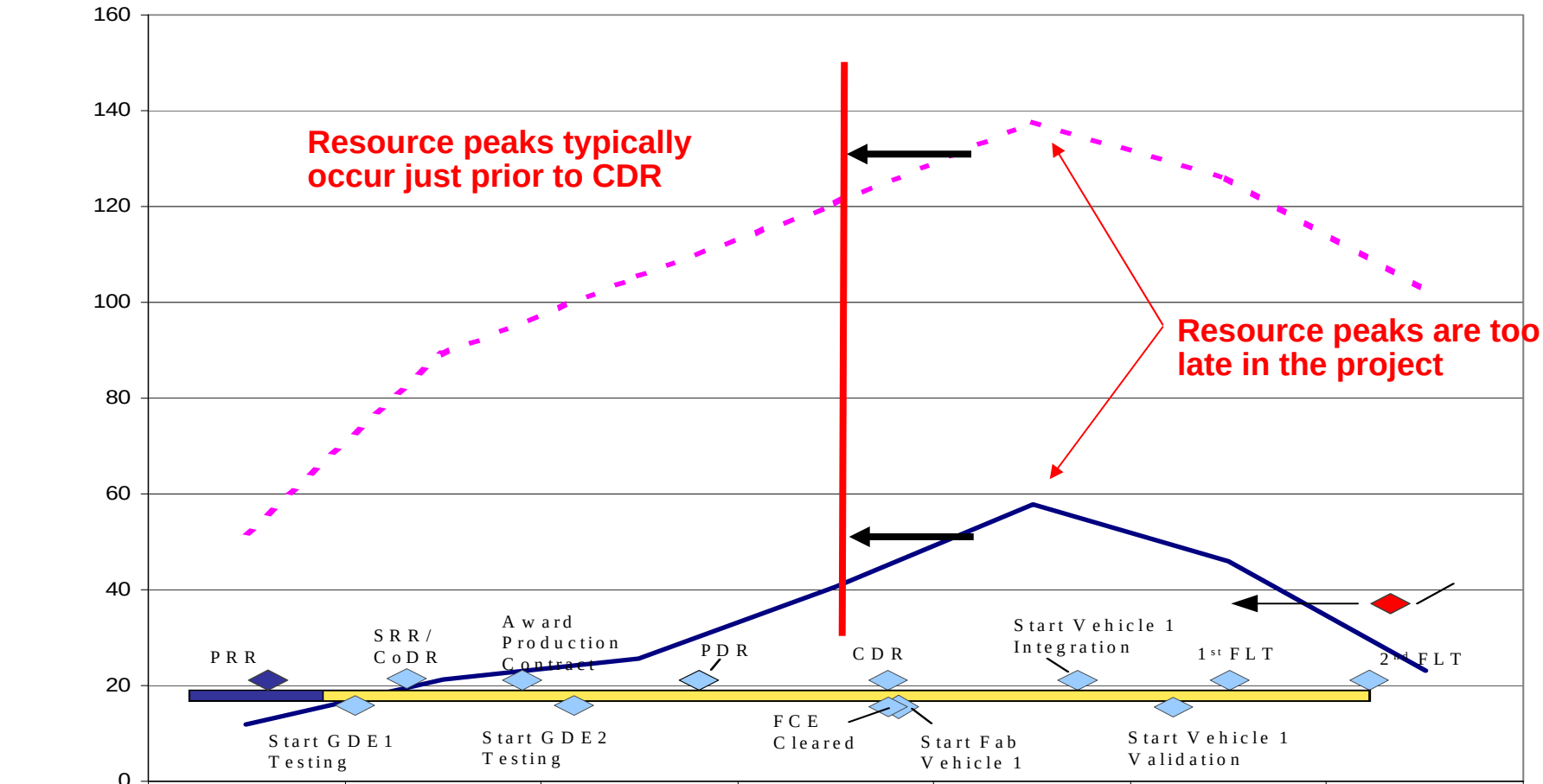
Completion Std Deviation: 63.23 days
95% Confidence Interval: 5.54 days
Each bar represents 20 days
(Risk Areas 2, 3, & 5 are –10% and + 20%, 1, 4, 6, 7, 8, 9 & 10 are –5 and +30%)



Completion Probability Table

Prob	Date	Prob	Date
0.05	4/19/07	0.55	8/28/07
0.10	5/11/07	0.60	9/6/07
0.15	5/29/07	0.65	9/24/07
0.20	6/13/07	0.70	10/8/07
0.25	6/28/07	0.75	10/25/07
0.30	7/6/07	0.80	11/13/07
0.35	7/17/07	0.85	12/10/07
0.40	7/26/07	0.90	1/4/08
0.45	8/3/07	0.95	2/14/08
0.50	8/17/07	1.00	4/16/08

Test #6 – Summary Level Cost/Schedule Correlation Check

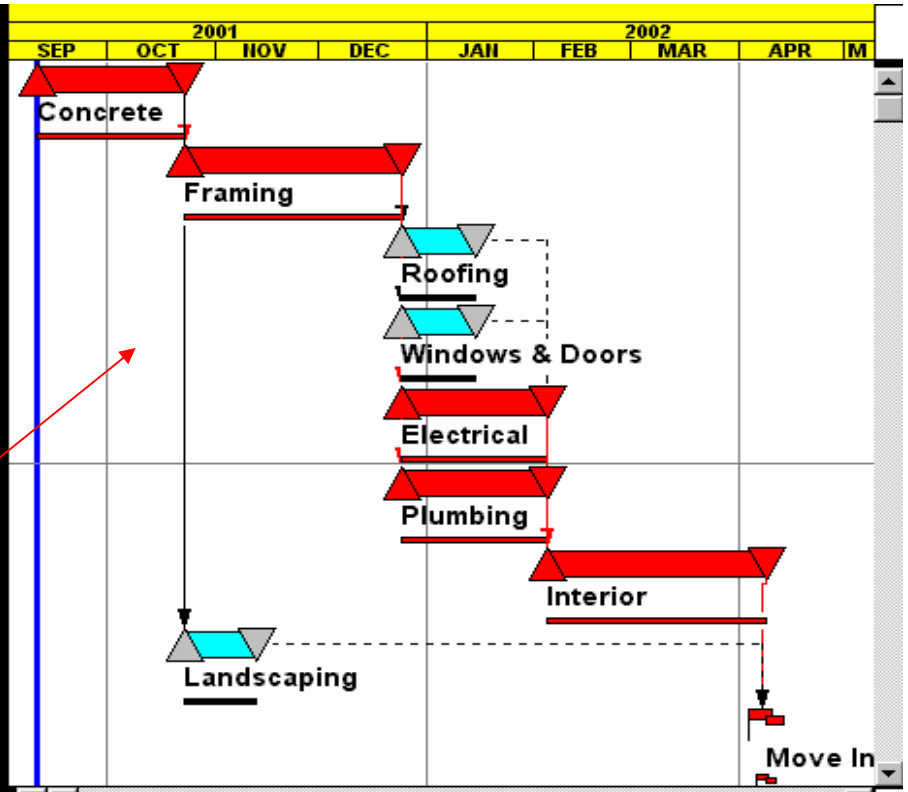


	FY 02	FY03	FY04	FY05	FY06	FY07	FY08
FTEs	40	68	80	80	80	80	79
NOA	12	21.1	25.6	40.6	57.9	45.9	23.1

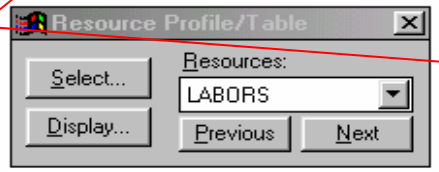
Other Assessment Considerations

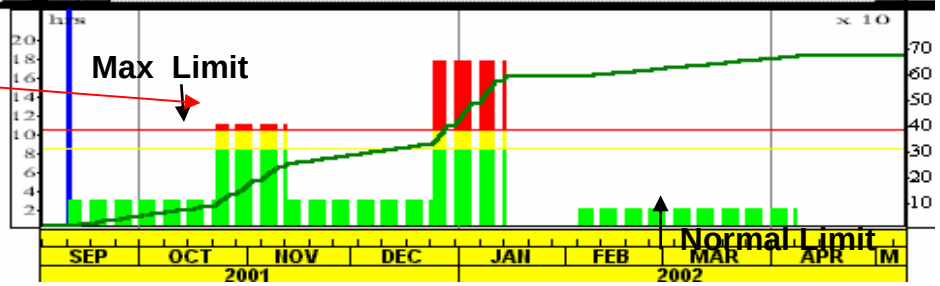
Resource Loading Ensures Cost/Schedule Integration

Activity ID	Activity Description	Orig Dur	Rem Dur	%	Early Start	Early Finish	Total Float
100	Concrete	30	30	0	11SEP01	22OCT01	0
200	Framing	45	45	0	23OCT01	24DEC01	0
300	Roofing	15	15	0	25DEC01	14JAN02	15
400	Windows & Doors	15	15	0	25DEC01	14JAN02	15
500	Electrical	30	30	0	25DEC01	04FEB02	0
600	Plumbing	30	30	0	25DEC01	04FEB02	0
700	Interior	45	45	0	05FEB02	08APR02	0
800	Landscaping	15	15	0	23OCT01	12NOV01	105
900	Move In	0	0	0		08APR02	0



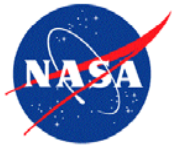
Electronic Integration Ensures Consistency between Budget Plan & Schedule Plan





Not resource leveled

Test #7 - Major Project Milestone Tracking Check

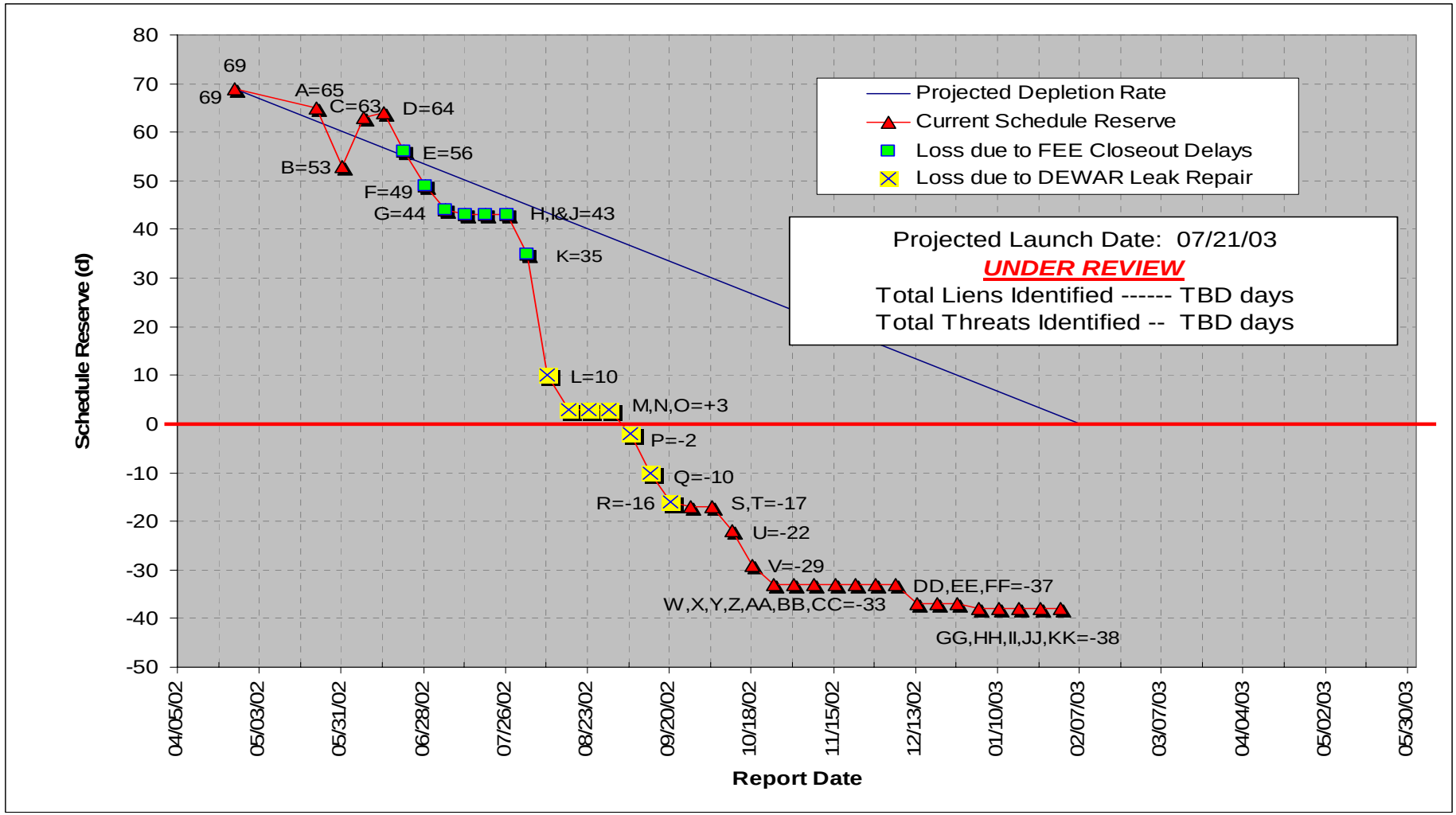


Task Name	2000 3	2000 4	2001 1	2001 2	2001 3	2001 4	2002 1	2002 2	2002 3	2002 4	2003 1	2003 2	2003 3	2003 4	2004 1	2004 2	2004 3	2004 4	2005 1	2005 2	2005 3	2005 4	2006 1	2006 2	2006 3	2006 4	2007 1	2007 2	2007 3	2007 4
Project Major Milestones																														
Project ATP			1/6																											
SRR/SDR (4/11/01)				4/11																										
Program Commitment Agreement (PCA)					7/26																									
Preliminary Design Review (PDR)									10/18																					
Pathfinder & Fitcheck Complete														10/1																
Critical Design Review (CDR)														12/11																
System Functional Test Complete																	10/22													
Horizontal Static Firing Test Complete																			6/6											
DCR																			6/6											
Acceptance Review (AR)																							6/13							
Flight Readiness Reviews (FRR) Complete																										10/31				
First Flight (STS-XXX Launch)																										10/31				

Baseline △ **Current** ◇ **Status As Of: 6/30/02**

- **Slips of early key project milestones normally lead to slips in key milestones later in the project**

Test #8 – Schedule Reserve Tracking Check



- **Identifies the amount of project schedule margin in the plan and tracks the usage of that reserve**

Questions?